

We claim:

1. A bypass valve assembly which selectively operates to establish a bypass path for a fluid in a delivery system, comprising:
 - 5 a body member having a fluid inlet connectable to the delivery system and a bypass fluid outlet;
 - a piston assembly supported within the body member, the piston assembly slidable between a closed position, a first open position and a second open position, the piston assembly preventing fluid flow
 - 10 from the inlet to the bypass fluid outlet in the closed position; and means for biasing the piston assembly in the closed position when the delivery system pressure is between an upper first threshold pressure value and a lower second threshold pressure value, for moving the piston assembly to the first open position when the
 - 15 delivery system pressure exceeds the first threshold pressure value whereby fluid flow is permitted from the fluid inlet through the bypass fluid outlet, and for moving the piston assembly to the second open position when the delivery system pressure is less than the second threshold pressure value whereby fluid flow is permitted
 - 20 from the fluid inlet through the bypass fluid outlet.

2. The bypass valve assembly of claim 1 wherein the body member has a pressure inlet orifice, and wherein the means for biasing the piston assembly comprises:

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a cage assembly slidably supported in the body member and having a
plunger member and an annular collar, the plunger member
connected to the annular collar by at least one standoff flange
members, the plunger collar forming with the body member an
5 interior chamber in fluid communication with the pressure inlet
orifice;

means for biasing the piston assembly toward the fluid inlet; and

means for biasing the cage assembly toward the pressure inlet orifice.

10 3. The bypass valve assembly of claim 2 wherein the means for
biasing the piston assembly comprises:

a first spring disposed between the piston assembly and the plunger
member of the cage assembly; and

a second spring disposed between the inlet of the body member and the
15 annular collar of the cage member.

4. The bypass valve assembly of claim 3 wherein the piston assembly
has a sealing surface and the body member has an annular sealing junction.

20 5. The bypass valve assembly of claim 4 wherein the cage assembly
comprises:

means for sealing between the plunger member and the body.

6. The bypass valve assembly of claim 5 wherein the piston assembly
25 has at least one exit orifice and an interior surface, the exit orifice sealed from

communicating with the bypass outlet when the piston assembly is in the closed position, and the exit orifice communicating with the bypass outlet when the piston assembly is in either the first or second open positions.

7. A bypass valve assembly selectively operated to bypass a delivery fluid, comprising:

a housing assembly having a fluid inlet, a bypass fluid outlet and a pressure inlet;

5 a cage assembly slidably supported within the housing and having a plunger end and a piston retaining end, the plunger end forming with the housing an interior chamber in fluid communication with the pressure inlet;

a piston assembly slidably supported by the cage assembly;

10 first biasing means for biasing the piston assembly to a closed position in which fluid flow is prevented between the fluid inlet and the bypass fluid outlet;

second biasing means biasing the plunger toward the pressure inlet; and

wherein the piston assembly is slidable from the closed position to one of a

15 first open position and a second open position, the piston assembly biased to the closed position when the delivery system pressure is between an upper first threshold pressure value and a lower second threshold pressure value, to the first open position when the delivery system pressure exceeds the first threshold pressure value whereby
20 fluid flow is permitted from the fluid inlet through the bypass fluid outlet, and to the second open position when the delivery system pressure is less than the second threshold pressure value whereby fluid flow is permitted from the fluid inlet through the bypass fluid outlet.

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8. The bypass valve assembly of claim 7 wherein the first biasing means comprises:

a first spring supported in the cage assembly between the plunger end and the piston retaining end.

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9. The bypass valve assembly of claim 8 wherein the second biasing means comprises:

a second spring supported between the housing and the piston assembly.

10 10. The bypass valve assembly of claim 9 wherein the piston assembly has a sealing surface and the housing assembly has an annular sealing junction.

11. The bypass valve assembly of claim 9 wherein the cage assembly comprises:

15 means for sealing between the plunger member and the housing assembly.

12. The bypass valve assembly of claim 11 wherein the piston assembly has at least one exit orifice in fluid communication with the bypass fluid outlet and an interior surface in fluid communication with the fluid inlet, the exit orifice
20 sealed from communicating with the bypass outlet when the piston assembly is in the closed position, and the exit orifice communicating with the bypass outlet when the piston assembly is in either the first or second open positions.

13. A bypass valve assembly selectively operated to bypass a delivery fluid, comprising:

a housing having a fluid inlet, a bypass fluid outlet and a pressure inlet;

a cage assembly slidably supported within the housing and having a

5 plunger end and a piston retaining end, the plunger end forming with the housing an interior chamber in fluid communication with the pressure inlet;

a piston assembly slidably supported by the cage assembly;

first spring supported in the cage assembly between the plunger end and the

10 piston retaining end for biasing the piston assembly to a closed position in which fluid flow is prevented between the fluid inlet and the bypass fluid outlet;

a second spring supported between the housing and the piston assembly,

the second spring biasing the plunger toward the pressure inlet; and

15 wherein the piston assembly is slidable between a closed position, a first open position and a second open position, the piston assembly preventing fluid flow from the inlet to the bypass fluid outlet in the closed position, the piston assembly biased to the closed position

when the delivery system pressure is between an upper first
20 threshold pressure value and a lower second threshold pressure value, to the first open position when the delivery system pressure exceeds the first threshold pressure value whereby fluid flow is permitted from the fluid inlet through the bypass fluid outlet, and to the second open position when the delivery system pressure is less

than the second threshold pressure value whereby fluid flow is permitted from the fluid inlet through the bypass fluid outlet.

14. The bypass valve assembly of claim 13 wherein the piston assembly
5 has a sealing surface and the housing assembly has an annular sealing junction.

15. The bypass valve assembly of claim 14 wherein the cage assembly comprises:

means for sealing between the plunger member and the housing assembly.

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16. The bypass valve assembly of claim 15 wherein the piston assembly has at least one exit orifice in fluid communication with the bypass fluid outlet and an interior surface in fluid communication with the fluid inlet, the exit orifice sealed from communicating with the bypass outlet when the piston assembly is in
15 the closed position, and the exit orifice communicating with the bypass outlet when the piston assembly is in either the first or second open positions.